PROJECT 2 OVERVIEW
Develop Common Criteria for Reporting Injuries and Fatalities

BACKGROUND

In September 2000, the Bureau of Transportation Statistics (BTS) published the Safety Data Action Plan with the goal of providing the U.S. Department of Transportation (DOT) with data of a quality sufficient to identify, quantify, and minimize risk factors in U.S. travel. The Safety Data Action Plan identified several research projects to address specific shortcomings in current data collection and data quality within the various DOT databases.

The synthesis of the recommendations from this extensive research program can provide the foundation for a plan to improve data quality and comparability within DOT. It is anticipated that these improved data will lead to interventions that will advance the DOT Strategic Safety Goal of eliminating transportation-related deaths, injuries, and property damage.

Objective

The objective of this project was to devise injury coding standards for all DOT databases. This would ensure uniformity in injury event definitions and reporting criteria across modes and include sufficient mechanistic cause information for development of intervention strategies.

GENERAL APPROACH

The general approach was to inventory DOT and selected non-DOT databases, and identify, describe, and explore opportunities to reach the objective.

Scope

The scope was limited to a review of U.S. transportation safety databases including air, water, road, rail, transit, and pipeline, as well as a review of standards and best practices from non-transportation injury data systems or coding protocols. This review focused on data related to acute non-intentional injuries sustained by transportation workers and travelers, but also considered the potential for reporting chronic injuries and disabilities and intentional injuries such as homicide and suicide.

Data Sources

The data sources included the following federal agencies:

Department of Transportation agencies:
- Federal Aviation Administration (FAA)
- Federal Motor Carrier Safety Administration (FMCSA)
- Federal Transit Authority (FTA)

- Maritime Administration (MARAD)
- National Highway Traffic Safety Administration (NHTSA)
- Research and Special Programs Administration (RSPA) (under the Office of the Secretary of Transportation; includes hazardous materials, pipeline safety, and other special projects not mode-specific)
- U. S. Coast Guard (USCG)

Other federal agencies:

- National Center for Health Statistics of the Centers for Disease Control and Prevention (NCHS/CDC)
- National Institute for Occupational Safety and Health (NIOSH)
- Consumer Product Safety Commission (CPSC)
- National Transportation Safety Board (NTSB)
- Department of Defense (DOD)

Purpose of Injury Investigation/Data Collection

Investigations of transportation incidents are intended to determine the cause(s) of the incidents. DOT's Strategic Safety Goal is to "promote the public health and safety by working toward the elimination of transportation-related deaths, injuries, and property damage." The overriding philosophy is that the determination of cause factors will lead to prevention strategies. Although the elimination of injury-producing incidents is a justifiable and laudable goal, few believe it is achievable as long as humans are involved in the design, manufacture, operation, and maintenance of transportation systems. This is particularly true considering the constantly increasing exposure in most, if not all, transportation modes.

A secondary goal of incident investigation and data collection should be to determine the cause(s) of injury. An appropriate balance needs to be reached between efforts directed toward incident prevention and those directed toward injury prevention. This secondary goal is frequently overlooked or underemphasized in the investigation of transportation incidents either because it is not recognized as important by the investigating agency or because of resource limitations. Some have argued that injury and survival factors investigations are unnecessary and detract from the main focus of investigations — the prevention of incidents. Such reasoning is based on the now discredited "zero defect" mentality that persisted in the 1970s and 1980s. In order to meet the DOT Strategic Safety Goal, both aspects of incident investigation must be aggressively pursued.

Injury investigation and the recording of injury data in transportation databases is generally undertaken to meet one or more of four main objectives:

1. to determine the "severity" of an incident,
2. to aid in the calculation of the "cost" of transportation incidents,
3. to provide a basis for management decisions related to prioritization and resource allocation, and
4. to provide a basis for developing prevention/mitigation strategies.

The first two objectives can be achieved with relatively rudimentary injury data, such as recording whether each person involved in the incident received fatal injuries, was otherwise injured, or was uninjured.

Depending on the goals of the organization, the third objective may be met with either rudimentary or more detailed data. To meet the fourth objective of providing a basis for developing injury mitigation strategies, however, requires not only descriptive data on the nature of the injuries sustained by persons involved in an incident, but also information relating to the mechanism or cause of those injuries.

Clearly, one cannot develop an effective prevention strategy for a particular type of injury if that injury is not adequately described and if the cause of the injury is not known. Consequently, the development of a database that can be used to formulate injury mitigation strategies requires considerably greater amounts and specificity of data than a database designed to meet the other objectives listed above.

The mechanism of an injury can be described on various levels. Frequently, the term is used in its general sense to describe the activity that caused a person to be injured. Examples include “automobile crash,” “fell from a height,” or “involved in an explosion.” Although this level of description provides some useful data, it states the obvious in most transportation incidents, and is thus not very useful for developing mitigation strategies. A more useful level of description requires the identification of the particular injury such as “left distal tibia fracture” and a clear mechanism of that injury such as “floorboard deformed inward.” This detailed joint description of injury and cause gives a clear picture not only of the injury but also of the specific cause of that injury. A database with this level of description allows the user to identify and quantify the occurrence of that injury and its associated mechanism over time and also suggests a mitigation strategy — prevent the floorboard from deforming. Without such data, analysts could identify the injury, but the cause and potentially effective mitigation strategies would be left to speculation.

Detailed injury and mechanism data are indispensable in identifying and quantifying injury causes and performing a cost-benefit analysis of proposed prevention strategies. However, collection of reliable mechanistic data requires well-trained investigators, detailed analysis of the incident scene, and a higher level of resource commitment than is currently available in many incident investigations. Specifically, the process requires an analysis and description of all significant injuries, careful analysis of the environment to which the injured was exposed, an analysis of protective equipment (e.g., seats and restraints) to determine function or lack of function and use, and a knowledge of the crash dynamics, incident circumstances, and related structural failure modes.

Longitudinal analysis can identify consistent injury mechanisms suggesting the need and method of implementing injury prevention strategies and providing the justification for the expenditures involved. Such analysis was responsible, for example, for the improvements in automobile restraint technology introduced in the U.S. market over the past 40 years. In the 1960s, the lap belt was introduced into automobiles primarily to prevent ejection of occupants from vehicles during crashes. Subsequently, it was shown that although the lap belt prevented occupant ejection, it did not prevent upper torso and head contact with internal structures, and it even caused a constellation of injuries later referred to as the “seat belt syndrome." Consequently, the lap/shoulder harness restraint system was

introduced. This innovation greatly reduced the injuries identified in many previous crashes, but was it shown to be insufficient to protect front seat occupants in other types of crashes. This led to the development of the air bag, which was first offered to enhance protection in frontal collisions for drivers, then all front seat occupants, and was subsequently refined to avoid certain serious injuries caused by the air bags themselves in some cases. Now the technology has been extended to protect both front and rear occupants in side impacts. These innovations have all been based on knowledge of injuries and causal mechanisms derived through crash investigations and a database with sufficient data to perform an accurate analysis and quantification of injury mechanisms.

Therefore, in a program to provide common injury data and common injury and event definitions across all modes of transportation, it is vital to establish clear objectives for the use of the data and to ensure that new data systems provide a sufficient level of detail, quality, and commonality to meet those objectives. To provide a data system that will provide a sufficient level of detail to develop and justify injury mitigation strategies will require that mechanistic data be collected and stored. For some modes, this will require a considerably higher level of commitment to incident investigations in terms of trained investigators and financial resources than currently available. Other modes currently have such systems in place.

INJURY INFORMATION COLLECTED BY EACH MODE

General

Each transportation mode is regulated by at least one federal agency with at least one database on injuries and property damage but with little coordination of data collected, definitions of events or injuries, or data-collection methods. The *Volpe National Transportation Systems Center Report* provided a comparison of reporting criteria and how fatality and injury data are captured and reported within agency databases. The working group for this project (2) obtained basic data for comparison from the Volpe report and provided more data on non-DOT databases.

Comparison of Databases

Injury Criteria Utilized in Existing Databases

The working group developed a matrix comparing each data source on 10 factors: agency responsibility with respect to injury investigation, identity and training of data collectors, nature of data sources, definitions of events that trigger investigation or report, event and circumstance inclusion criteria, inclusion of data on uninjured, fatality definition, injury definition, injury coding, and statutory requirements governing the scope of investigation and reporting.

Event Definitions

Most agencies use one or more of four factors as the threshold for reporting an incident: degree of injury, dollar amount of property damage, amount of substance released into environment, and type of occurrence. There is mode specificity and wide variation on each factor, although all

agencies report fatalities at the scene involving operation of a vehicle or pipeline.

Fatality Definitions
In some cases, whether a fatality is deemed transportation-related and reportable may depend on the function of the fatally injured person at time of death. Agencies also vary in the maximum elapsed time between injury and death permitted for reporting, with FRA allowing up to 365 days, while transit, highway, and aviation agencies allow up to 30 days, and pipeline and marine agencies do not specify any such limit.

Injury Definitions
Criteria for reporting injury vary widely. Examples include injuries requiring hospitalization, needing to be carried from the scene, needing medical treatment, disability beyond the day of injury, incapacitation or hospitalization beyond 24 hours, and so forth.

Person Inclusion Criteria
The function or location of victims at the time of an incident frequently determines if their injuries are reportable, and the specific criteria for inclusion vary widely across databases.

Uninjured Persons
Databases vary widely in whether or how uninjured occupants or bystanders are reported.

Data Collectors
The training and background of persons investigating and reporting data varies widely, with trained professional investigators in some modes, self-reporting owners or operators in others, and combinations of police accident reports and trained investigators in the NHTSA database.

Injury Coding
There is no universally accepted system of injury classification and coding among any databases known to the working group. Most schemes focus on injury description, severity, and mechanism. The Abbreviated Injury Scale (AIS) is the most widely used and accepted system, classifying injury by body part, specific lesion, and severity on a 6-point ordinal scale with a 7th-digit to code "Unknown," where severity is looked at in terms of the threat to life of a single injury without respect to combined effect of multiple injuries on one person. The Injury Severity Score (ISS) and the Maximum AIS (MAIS) are functions of the AIS on a single injured person that measure overall injury severity. Most hospitals encode discharge diagnoses using the International Classification of Diseases, Clinical Modification, 9th Edition (ICD-9CM), which classifies injury and other diagnoses by a numerical code and will be revised within a year (ICD-10CM). A published conversion table exists to translate ICD-9CM codes into AIS. AIS does not specify injury mechanism or body part aspect (e.g., left or right, superior or inferior, anterior or posterior). The KABCO scheme allows nonmedically trained persons to make on-scene injury severity assessments, where K = Killed, A = Incapacitating Injury, B = Non-incapacitating injury, C = Possible injury, and O = No injury.

Discussion

Due to the wide variation among DOT modal agencies in event definitions, type and detail of injury data, and methods and resources applied to incident investigation and injury reporting, achieving common

criteria will require major changes in practices and resource allocation, and associated *Code of Federal Regulations* (CFR) specifications, in some or all agencies. The working group considered two approaches to establishing common criteria for reporting injuries and death: a minimal "least common denominator" approach and a proven current systems approach. The minimal approach would adapt the existing method with the least complexity and resource allocation to all modes to allow general cross-modal comparison of injury cost and severity, but would not provide sufficient data to identify injury causes or develop practical mitigation strategies.

In contrast, two proven current systems provide data sufficient to identify injury causes and support development and justification of mitigation strategies: the National Automotive Sampling System Crashworthiness Data System (NASS CDS) and the U.S. Army Aircraft Accident Reporting System (USA AARS). While the NASS CDS is a probability sample using trained investigators or analysts, the USA AARS is a total reporting system (census), using physicians to record the data. Both systems are based on AIS 90 with additional fields for pertinent injury and mechanism information. NHTSA and automobile manufacturers routinely use NASS CDS data to identify and mitigate injury hazards and to justify or oppose proposed rulemaking. The U.S. Army routinely uses USA AARS data to identify and mitigate causal factors associated with injuries.

RECOMMENDATIONS

General

In spite of the marked differences among transportation modes in event and injury definitions, inclusion criteria, and the reporting and coding of injury data, establishing common criteria for such reporting among the modes is a technically achievable goal. The main impediment to achieving the goal will be resource allocation. Nevertheless, in the spirit of the Safety Data Action Plan and DOT Strategic Safety Goal, the working group has developed the following set of recommendations that it believes will promote commonality among the modes and also improve the quality and utility of mechanistic incident and injury data for development of strategies to prevent injuries in vehicular crashes and other transportation-related incidents.

Event Definition

The working group recommends that all modes adopt the following definition of a reportable event.

Any incident involving the movement or operation or intended movement or operation of a motor vehicle, vessel, aircraft, pipeline, or other conveyance in the course of transporting persons or goods from one place to another:

- that occurs within U.S. jurisdiction or involves a U.S. commercial carrier;
- where the cause is intentional or unintentional;
- that results in substantial property damage; or
- that results in injury (requiring medical attention beyond first aid) or

death of anyone (passengers, crew, pedestrians, other workers, or bystanders) within 30 days of the event.

Fatality Definition
A transportation-related fatality one that results from injuries incurred in a transportation incident when the death occurs within 30 days of the incident.

Injury Definition
A transportation-related injury is one requiring medical attention beyond first aid given in a transportation incident.

Uninjured
To evaluate injury prevention countermeasures and the hazard associated with design features or environmental structures, record data for both injured and uninjured individuals exposed to the same potentially injurious event. At a minimum, age, sex, seating position, and occupant restraint use and availability should be recorded for uninjured individuals exposed to a reportable event.

Injury Classification and Coding
The working group recommends an injury reporting system patterned after the NASS CDS, with at least the following elements:

- source of injury data,
- complete AIS 90 code, including severity code,
- aspect of injury 1,
- aspect of injury 2, and
- injury source (one or more data fields).

Because injury mechanisms differ markedly across modes, an encompassing set of common codes cannot be developed for use across all modes. The working group recommends that experts in each mode and/or database develop a set of codes patterned after the NASS CDS or USA AARS, after which commonalities can be identified and implemented while maintaining necessary mode-specific codes. The working group recommends a cost-benefit analysis of the feasibility of applying the adopted standards to historical data in DOT databases. If modes elect not to adopt the recommended common coding method, then the working group recommends that they adopt AIS for some commonality with other modes, and if the latter is not elected by a mode, then the mode is urged to adopt KABCO or a modification thereof as part of their injury-coding scheme.

Other Recommendations

Finally, the working group suggests two other recommendations that were outside the scope of the current project. First, each mode or database manager should consider opportunities for limiting detailed investigations of incidents to a valid statistical sample as has been done by NHTSA in the NASS CDS database. Sampling requires a high volume of incidents for precise statistical estimation. For this reason, it will not be practical for all modes, but it should be considered for general aviation and, most likely, recreational boating. Second, each mode should pursue opportunities for linking transportation databases to hospital databases, state or territory vital statistics, and other medical databases. Such linkages have the potential of reducing workload and resource requirements as well as increasing the accuracy of injury recording.